

Chapter 5

A Comprehensive Solution for Ambient Intelligence: From Hardware to Services

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ABSTRACT

Ubiquitous computing, pervasive computing, ambient intelligence, etc. are research lines that, with slight differences, emphasizes their efforts in improving everyday life of users. However, all these approaches share a common set of requirements, for the underlying IT infrastructure, devoted to support advanced services. A key component of these, sometimes called “new paradigms”, is the fact that technology is found embedded in the environments where we live. In this paper we are going to propose a comprehensive vision for modelling this type of environments from a practical point of view. This work covers HW developments, which seamlessly integrate in the environment, to automatically generate services based on user needs. In the last decade, authors of this work have been proponents of a unified approach, based on the distributed object abstraction, allowing synergies to be better exploited. Remote device management, wireless sensor and actuator networks, hardware components and now even reconfigurable hardware platforms and service platforms are considered as part of a large evolving system sharing a common middleware and a single design methodology.

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INTRODUCTION

Ambient intelligence (AmI) focused on users and their needs. It provides services to users anticipating their actions and modifying the environment, facilitating their everyday tasks. In 2001 the ISTAG published the work entitled “Scenarios for Ambient Intelligence in 2010”. That work described a set of scenarios showing interaction among users and the information and communication technologies. Nowadays it can be affirmed that maybe they were too optimistic. Nevertheless, the Ambient Intelligence vision described in that document is still valid. Furthermore, the described scenarios can be used as guidelines for research purposes. This chapter is devoted to deal with a recurrent problem in Ambient Intelligence as it is the integration of heterogeneous devices, technologies and services, that are to be deployed in an Ambient Intelligence environment.

In the same line, Ubiquitous Computing (UC) is all about heterogeneity, it deals with heterogeneity in heterogeneous ways. Some authors identify different areas of UC leading to different approaches to the development of Ubiquitous Computing environments (Endres, 2005). Sometimes there is an explicit distinction between Ubiquitous Computing and Pervasive Computing (Gaber, 2007) to differentiate the main focus. Pervasive Computing deals with providing adaptive or emerging services to fit user needs in a given context, whereas Ubiquitous Computing would be mainly focused on globally accessible services (anytime, anywhere).

Additionally, most research topics in UC must also deal with the fact that the target systems are inherently distributed. Therefore UC environments have much in common with distributed heterogeneous object platforms developed in the nineties (CORBA, EJB, DCOM,...) and also with current grid computing platforms (Globus, gLite,...). Our research tries to leverage the achievements of those platforms by defining a unified middleware with the capability to interact

with standard middlewares although specially suited to UC needs.

One major source of heterogeneity is the wide variety of devices connected by means of different networking technologies in almost every UC or AmI environment. The concept of residential gateway was coined in the field of residential services as an analogy to a concentrator that is to say, a device with multiple network interfaces used to interconnect all the device networks available in a given scenario. Middlewares like OSGi (OSGi, 2004) or Amigo (Georgantas, 2005) took advantage of this mediating device so as to provide a whole service management platform. Implicit to this approach is the fact that most services will be running in the residential gateway. On the one side, this is positive from the point of view of manageability. The residential gateway may be controlled by the service provider or even by the telecommunication operator. But this device also constitutes a single point of failure which makes impractical the implementation of critical or very simple services (door opening, lighting,...).

With more and more candidate technologies being integrated in Ubiquitous Computing environments it is increasingly hard to design a residential gateway, at a reasonable cost, behaving as a single device with all required interfaces. From a business point of view, service providers are using residential gateways as a way to control the distribution of new services, limiting users' freedom to choose alternative service providers. While a mature market would see this as a competitive advantage, an emerging market such as the residential services sees a reduction of the perceived utility and consequently a slowdown in the rate of new deployments.

Currently DVB set-top-boxes, mobile phones, or public WiFi networks constitute alternative technologies for the interconnection of residential networks or device networks with an external service provider (e.g. through Internet). Therefore, the overall architecture of an ubiquitous environment is evolving from a star topology centred on

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